Lesson Study in Professional Learning Communities 2014-2016

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Lesson Study in Professional Learning Communities 2014-2016: experiences from the Netherlands

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abstract
This study explores teachers' experiences with Lesson Study (LS) in the Netherlands in the context of two cross-school Professional Learning Communities for teachers of Dutch language and mathematics of 13 secondary schools (2014-2017). Drawing on the research on effective teacher learning, the paper reports a quantitative study on the feasibility and value of Lesson Study as a vehicle for teacher learning in the Dutch context. In the school years 2014-2016, some 30 teachers carried out four Lesson Study cycles in teams of 3-6 persons. After each cycle teachers filled out an evaluation questionnaire. The findings show that teachers experience Lesson Study as feasible and valuable. Differences between the Lesson Study-teams were also found, in particular in the first year, due to interpersonal and conditional factors. The project so far demonstrates that LS has potential in the Dutch context as a model for teacher learning; however, interpersonal and conditional factors have to be respected if its use is to be expanded.

Introduction

Lesson Study (LS hereafter in this paper) in the Netherlands is a relatively new approach for teacher learning and is rapidly spreading. In LS, teachers collaboratively plan a research lesson, observe this lesson live, collect data and analyze them together to improve pupils' learning (Fernandez & Chokshi, 2002). LS is characterized by active collaboration and research, is practice based, student oriented and teacher directed; characteristics that are very similar to those of effective professional development as recently identified in several review studies (Darling-Hammond et al., 2009; Desimone, 2009; Kooy & Van Veen, 2012; Timperley et al., 2007). Therefore, LS is a theoretically powerful professional development approach. Besides, reviews of Xu and Pedder (2014) and Huang and Shimizu (2016) also confirm, though mainly based on small-scale qualitative research, that LS can be a powerful tool for teachers to improve their teaching practice.

However promising a new professional development initiative theoretically and empirically might be, an empirical base in a new context is required, since the question is always about to what extent it can be replicated elsewhere. The application of LS in the Dutch context is not self-evident, because standard professional development practices in the Netherlands are mostly top-down imposed quick fix and one shot workshops, conferences and seminars, and to a lesser degree teacher directed, practice based collaboration and research

(Onderwijscoöperatie, 2016). Besides, student-orientation is no common practice for Dutch teachers (De Vries et al., 2013), and just as in other Western European countries work pressure in schools is high (Inspectie van het Onderwijs, 2016). For the Dutch situation and with respect to LS in particular, Verhoef et al. (2014) have recently described some complexities of an LS in a small scale setting of three teachers of mathematics. This brings us to the purpose of this paper where we plan to explore the potential of LS for the Dutch context on a larger scale than Verhoef et al. (2014) did, it is comparable to the research by Cajkler et al. (2014) who explored the potential of LS for the English context. Our context of study are two Professional Learning Communities (PLCs), three-year pilot projects (2014–2017) for Dutch as mother tongue and mathematics. They were launched in 2013 by the Dutch Ministry of Education in the Netherlands to enhance the professional learning of experienced, secondary school teachers and the learning culture in their schools. The two PLCs consist of some 30 teachers of 13 different secondary schools spread throughout the North Netherlands. The main research question in this study is: what is the feasibility and value of LS as a new approach for teacher learning for these teachers and their schools?

Teacher learning

The earlier mentioned workshop, conference and seminar tradition dates from the behavioristic age, where teacher learning was not a topic in itself (Scheerens, 2010; Villegas-Reimers, 2003). Since the 1980s, and as a result of changing economic, social and educational developments, teachers gradually began to be expected to continue to learn over the course of their careers (Beijaard et al., 2007; Hargreaves, 2000), but the courses offered to teachers most often were fragmented, disconnected and irrelevant to the real problems of their classroom practice (Lieberman & Mace, 2010). Nowadays teachers are viewed as learning-oriented, adaptive experts, able to teach increasingly diverse sets of learners, knowledgeable about student learning, competent in complex academic content and skillful in the craft of teaching (Vermunt & Verloop, 1999; Wei et al., 2009). Because the knowledge, skills and attitudes needed for this complex teaching profession cannot be developed fully in initial teacher education programs (Feiman-Nemser, 2001; Hammerness et al., 2005), career-long learning is expected of all teaching professionals (Day & Sachs, 2004). Current research on teacher learning draws on various perspectives, such as cognitive psychological (e.g., Borko & Putnam, 1996; Cochran-Smith & Lytle, 1999; Putnam & Borko, 2000), and adult/workplace learning approaches (e.g., Eraut, 2000; Lave & Wenger, 1991; Schön, 1983). Recently, both cognitive psychological and adult/workplace learning approaches have developed from an individualist to a more situative view of learning and share a conception of active, self-directed, constructive and reflective learning, which is situated in physical and social contexts and embedded in both individual and collaborative activities to link new knowledge with existing knowledge. In accordance with this conception of learning and also consistent with other researchers in the field of teacher learning (e.g., Bakkenes et al., 2010; Beijaard, 2009; Feiman-Nemser, 2001), we view teacher learning as a career-long, self-directed and active process, during which teachers engage in various formal and informal learning activities, on and off the job, in line with teacher work goals to change their knowledge and beliefs (cognition) and/or their teaching practices (behavior). Characteristics of learning activities associated with improved teacher quality and student learning outcomes

identified by recent research on effective teacher learning are active, collaborative, inquiry based, practice based, student oriented and teacher directed (Darling-Hammond et al., 2009; Desimone, 2009; Kooy & Van Veen, 2012; Timperley et al., 2007). LS has characteristics which are very similar to those just mentioned, and perfectly fits our concept of teacher learning.

Lesson Study

LS is a professional development approach that originated from Japan, and has spread the globe since 1999. Within and outside Japan, there is evidence that LS has contributed to teachers' professional development, improving teaching practice, improving students' learning and building and sustaining professional learning community (e.g. reviews of Xu & Pedder, 2014 and Huang & Shimizu, 2016). Recently, several attempts have been made to theorize LS and to unpack why and how LS works (e.g. Dudley, 2013; Runesson, 2015). Lewis et al. (2009) built and used a theoretical model based on the earlier mentioned cognitive learning and situated learning theories to investigate the mechanisms by which LS can be effectively used for instructional improvement outside of Japan. Firstly, the model posits that LS makes various types of knowledge more visible, thereby enabling teachers to encounter new or different ideas, and to refine their knowledge, according to cognitive theories. Secondly, the model posits that LS enables teachers to strengthen professional community, and to build the norms and tools needed for instructional improvement, as situated theories of learning propose (Lewis et al., 2009: 286). The model includes four LS features (investigation, planning, research lesson, and reflection), and three pathways through which LS improves instruction: changes in teachers' knowledge and beliefs; changes in professional community; and changes in teaching-learning resources. Since our focus is on the feasibility and value of the LS process in the Netherlands, in this paper we draw exclusively on the performance of the four features of the theoretical model. The first feature, investigation, means considering pupils' current characteristics and long term goals for student learning and development, and studying the content area: key concepts, existing curricula, standards, learning trajectory, research. Planning implies selecting or developing the research lesson, anticipating pupil solutions, and writing up the instructional plan, including goals for pupil learning and development, anticipated pupil thinking, data collection points, rationale for lesson design and connection to long-term goals. The third feature is the research lesson. One of the team members conducts the research lesson, and the other team members observe and collect data during this live research lesson. The last feature is reflection: team members share and discuss data from the research lesson, and they draw out implications for lesson redesign, for teaching-learning more broadly, and for understanding of pupils and subject matter. Finally, they summarize in writing what was learned from the cycle to consolidate the learning. Research based on this theoretical model by Lewis et al. (2009) yielded evidence that the LS work affected each of the three pathways, and provided an 'existence proof' of the potential effectiveness of LS in the US context.

Conditions for successful implementation

For successful implementation of professional development activities in teaching practice, all sorts of personal, interpersonal, and conditional factors have to be respected (Kooy & Van

Veen, 2012: Thurlings & Den Brok, 2014). In a study about feasibility and value of LS these factors cannot be ignored. Examples of personal factors are teachers' beliefs and motivation. In the context of the PLC project we are also investigating these personal factors. In the context of this paper, however, we focus exclusively on interpersonal and conditional factors. To investigate the interpersonal factors in the collaborative processes of LS, we chose the framework of Salas et al. (2005) that has featured effective team work with five components: team leadership, mutual performance monitoring, backup behavior, adaptability, and team orientation, and three coordinating mechanisms of shared mental models, closed-looped communication, and mutual trust, which is the most important interpersonal factor according to the review on collaborative teacher learning of Thurlings and Den Brok (2014). These components and mechanisms enable teachers to build the norms and tools needed for instructional improvement and to strengthen professional community (Lewis et al., 2009). With respect to conditional factors, these can be divided in intervention related factors and school related factors (Thurlings & Den Brok, 2014). Thurlings and Den Brok (2014) distinguish seven intervention related factors, including the role of the facilitator, given professional 'room', given guide lines, group size and group composition, factors that are very well applicable on the performance of LS in our context of PLCs. Finally, school related factors pertain to practical support of the school with regard to time and schedule issues, and to social support by the school management, factors that appear to benefit the process of collaboration (Thurlings & Den Brok, 2014).

Research questions

The main research question in this study (what is the feasibility and value of LS for Dutch teachers and their schools?) has been subdivided in the following research questions:

1. How do teachers value
    a. the feasibility of LS?(RQ1)
    b. LS as learning activity? (RQ2)
2. How do teachers value
    a. the collaboration in the LS teams? (RQ3)
    b. the PLC related conditions to perform LS? (RQ4)
    c. are a. and b. related (RQ5)?
3. How do teachers value the school related conditions to perform LS? (R6)
4. Can possible differences in collaboration and PLC related conditions be explained by gender, age, subject matter, teaching experience or teaching qualification? (RQ7)
5. How do teachers experience the feasibility and value of LS for their schools? (RQ8) This question will be answered after the third project year (2016-2017).

Method

For this paper, we chose a quantitative research design, although the limited amount of teachers involved in this project did not allow advanced statistical testing.

context

The context of this study consists of a three-year pilot project (2014–2017) launched by the Dutch Ministry of Education. The pilot concerns two PLCs, one for Dutch as mother language

and one for mathematics. For these PLCs, we chose LS as its professionalization approach. A first objective of the project is to improve teachers' instructional behaviors, in particular the more complex behaviors such as activating pupils and differentiating between them, since this is problematic for many teachers in Dutch secondary education (Dutch Schools Inspectorate, 2015). Secondly, both PLCs have their own content specific topic (reading skills for Dutch, and mathematical concepts for mathematics). In addition, the development of effective instructional resources is also an important goal for the PLC for Dutch. Thirdly, enhancing the learning cultures in the respective schools by introducing LS through the PLC members as future LS facilitators is another important aim of PLC. Each PLC is under the supervision of two subject pedagogy teacher educators from teacher education institutes affiliated to two regional universities. Furthermore, each PLC consists of a maximum of 15 teachers from totally 13 different secondary schools spread throughout North Netherlands. This LS configuration can be characterized as cross-school LS (Xu & Pedder, 2014). Teachers get 100 working hours for participation in the PLC, for which the school receives a modest compensation in the cost. The PLC is scheduled on Friday afternoon, and school managements were asked to schedule eventual research lessons also on Friday afternoon. The four subject pedagogy teacher educators and the overall project manager (author of this paper) form the PLC project group steering the PLCs. The directors of both teacher education institutes and two school leaders form the advisory board.

LS activities

The PLC-project started in February 2014 with a kick-off meeting for the schools involved where LS was briefly introduced. In the spring of 2014, two introductory meetings for the participating teachers were held both dealing with the content specific topic of the PLCs. As from September 2014, each school year (2014-2015 and 2015-2016) two LS cycles took place in LS teams of three to six teachers, three teams in the PLC Dutch and three teams in the PLC for mathematics. We chose an US adaptation of the original Japanese LS by Stepanek et al. (2007), including the same four steps (investigation, planning, research lesson and reflection, Lewis et al., 2009). Introduction in LS happened step-by-step through the teacher educators, who in their turn were introduced in LS by the project manager. During each cycle, the LS teams met for two (first year) or three (second year) investigation and planning meetings in the context of their own PLC. Teachers were introduced in a new topic of their content area in relation to the learning and teaching of this topic. Subsequently, they developed the research lesson, wrote down the instructional plan, including goals for pupil learning and development, anticipated pupil thinking and data collection points. The research lessons took place in the respective schools. One of the team members conducted the research lesson, and the other team members plus one of the subject pedagogy teacher educators or the overall project manager observed and collected data during live research lesson. The teachers visited each other's schools twice per cycle for observing the research lessons in the original and the adapted version, and for the post-lesson discussion (reflection). Each cycle was concluded with an evaluation and reflection meeting in the context of the PLC, where the LS teams shared and discussed data from the research lesson, drew out implications for lesson redesign, for teaching-learning more broadly, and for the understanding of pupils and subject matter. Several times per year, meetings were organized for school leaders of the schools involved to

inform them about LS activities and progress. For the colleagues and school managements involved, a closing conference, at which the LS teams presented their lesson studies and their lessons learned, was organized.

After the first cycle in the first year, and to prepare for their roles of LS facilitators in their own schools, the LS teams received a concise handbook on how to perform LS based on Stepanek et al. (2007). Furthermore, the subject pedagogy teacher educator fulfilled two roles: both the role of LS facilitator and the role of subject matter expert. In the second year, they concentrated more on their role of subject matter expert, and the LS teams functioned more autonomously with rotating roles.

During the two project years, the PLC project group monitored the performance of LS in the PLCs, and took action several times. As from the second cycle, an UK LS adaptation of the selection of three case pupils was introduced in order to stimulate the focus on pupil learning (Dudley, 2011). As from cycle three, there was explicit focus on both on the teacher as researcher as well as on the making visible of pupils' thinking. Resources were provided as well. It was also decided to change team composition and to reduce team size. Finally, in order to enhance positive collaboration, LS teams were asked to start the cycle with the discussion and development of group norms.

participants

In total 32 teachers participated in the PLCs during the first two years: 14 teachers of Dutch (1 male, 13 female) and 18 teachers of mathematics (seven male, eleven female). The average age is 42 years (range 26 – 59), and the average teaching experience in years is 15 (range 3 – 37). Seventeen teachers are fully qualified, and fifteen teachers have a qualification to teach junior forms of secondary education. The PLC project aims to facilitate LS in the participating schools through the PLC members. In order to find future LS facilitators, it was vital to find teachers that were 1) motivated; 2) didactically strong; 3) both student- as well as development- oriented; 4) willing to develop their activating and differentiating skills; and 5) as future LS facilitators potentially able to motivate colleagues for educational development, change and innovation. After the first year two teachers of Dutch and five teachers of mathematics left the PLCs for different reasons, personal (e.g. motherhood or journey around the world) or work related (e.g. new position in school management). In the second year, two new teachers of Dutch and two new teachers of mathematics joined the PLCs. Since we were able to sample all teachers involved in the PLCs, we used a homogeneous sampling approach in this research.

data collection

Data were collected by means of a paper questionnaire after each of the four LS cycles. This questionnaire was developed to measure five constructs: feasibility of LS, value of LS, collaboration, PLC related conditions and school related conditions. To operationalize the feasibility and value of LS, we relied on the theoretical framework of Lewis et al. (2009). For the first cycle 14 items, and from the second cycle 25 items spread over the four features were formulated in Dutch about feasibility (went the aspect in question more or less smoothly?) and value (is the aspect in question more or less conceived as a learning activity?) . Teachers could indicate on a five-point rating scale whether an item was applicable to them or not. Due

to the changing roles in LS as instructor or observer and due to non-attendance at one of the research lessons or a specific meeting, there were many missing values. Thus, it was not useful nor possible to calculate scale reliabilities.

For the third construct, collaboration within the LS team, we constructed eight items with a five-point rating scale based on Salas et al. (2005). Four times, a reliability analysis resulted in highly reliable scales (Cronbach's α = .90 -.94).

For the PLC-related conditions eight items were constructed that were based on Thurlings and Den Brok (2014). A reliability analysis resulted in reliable scales four times as well (Cronbach's α = .73 -.87).

For the last construct, school-related conditions, we used two items on provided support by the school management and provided time. The final collaboration items, the PLC-related conditions items and the two school-related conditions items, including means, standard deviations and minimum and maximum scores appear in Appendix 1.

data analysis

To give some indication of the feasibility and value of the four LS cycles, for RQ1 and RQ2 we calculated the means over the items per feature per cycle (see Appendix 2. and 3.), as well as the means over all features per cycle. For RQ3 and RQ4, we computed the mean scores of the scales, both for all participants of the PLCs and for the LS teams separately. Besides, we conducted one way ANOVA to assess the differences between LS teams in collaboration and PLC related conditions. To determine whether there is a link between teachers´ collaboration and PLC related conditions (RQ5), we computed correlations per cycle. For RQ6, we computed the mean scores of the two items with regard to the school-related conditions, both for all participants of the PLCs and for the schools separately. Since the groups per school are small, it was not possible to conduct one way ANOVA to assess for differences in school related conditions between the schools. For RQ7, independent sample t-tests served to assess the differences between gender, subject matter and teaching qualification, and one way ANOVAs for age and teaching experience.

Results

Findings are presented according to the above mentioned research questions.

feasibility of LS (RQ1)

In Table 1, we provide the mean scores for LS as a feasible activity per feature, per cycle and overall. Teachers appear to find LS feasible, in particular the research lesson and reflection. Teachers seem to find the investigation and planning parts a little less feasible.

Table 1
Mean scores for teachers' value of the feasibility of LS.

Scale	Cycle 1	Cycle 2	Cycle 3	Cycle 4	mean
Investigation	3.3	3.7	3.2	3.2	3.4
Planning	3.6	3.7	3.4	3.6	3.6
Research lesson	4.2	3.9	3.9	4.0	4.0
Reflection	3.9	3.9	3.9	4.0	3.9

value of LS as learning experience (RQ2)

In Table 2, we provide the mean scores for LS as learning activity per feature, per cycle and overall. The pattern teachers show with regard to learning experience is approximately the same as the one with regard to the feasibility of LS. In general, teachers appear to think that they learn from LS. They find the research lesson and reflection in particular instructive, and the planning part to a lesser degree. Teachers seem to find the investigation part a little less instructive.

Table 2
Mean scores for teachers' value of LS as learning experience..

Scale	Cycle 1	Cycle 2	Cycle 3	Cycle 4	mean
Investigation	3.4	3.6	3.4	3.2	3.4
Planning	4.1	3.9	3.7	3.6	3.8
Research lesson	4.4	4.1	4.0	4.1	4.2
Reflection	4.0	4.0	4.0	4.0	4.0

collaboration (RQ3)

In Table 3, we provide the mean scores for collaboration, overall per cycle and for each LS team per cycle. In general, the collaboration seems to go well in all four cycles. However, there appear to be differences between the LS teams (e.g. in cycle 1: Math2 m = 2.8 versus Math3 m = 4.5). We conducted a one way ANOVA to assess the differences between LS teams in collaboration, and they appeared significant for the cycles 1, $F(5,20) = 9.605$, $p < .01$ and 2, $(F5,20) = 8.46$, $p < .01$.

Table 3
Mean scores for teachers' collaboration, overall and per LS team.

Scale	Cycle 1	Cycle 2	Cycle 3	Cycle 4
Collaboration	3.8	3.7	3.9	3.9
Math1	3.9	3.6	3.8	4.2
Math2	2.8	3.2	4.3	3.8
Math3	4.5	4.6	4.0	4.2
Dutch1	4.1	4.5	3.4	4.2
Dutch2	3.2	3.1	3.8	3.7
Dutch3	4.1	3.4	4.5	3.3

PLC related conditions (RQ4)

In Table 4, we provide the mean scores for the PLC related conditions, overall per cycle and for each LS team per cycle. In general, the teachers appreciate the PLC related conditions, but again there are differences between the LS teams (e.g. in cycle 1: Math2 m=3.8 versus Math3 = 4.7 and Dutch3 = 4.7). We conducted one way ANOVA to assess the differences between LS teams in PLC related conditions, and they appeared significant for the cycles 1, $F(5,22) = 2.934$, $p < .05$ and 2, $(F5,19) = 3.361$, $p < .05$.

Table 4
Mean scores for teachers' PLC related conditions, overall and per LS team.

Scale	Cycle 1	Cycle 2	Cycle 3	Cycle 4
PLC related conditions	4.4	4.3	4.2	4.4
Math1	4.4	4.2	4.1	4.7
Math2	3.8	4.1	4.4	4.5
Math3	4.7	4.8	4.2	4.7
Dutch1	4.5	4.4	4.1	4.5
Dutch2	4.2	4.1	4.3	4.4
Dutch3	4.7	4.0	4.3	3.7

relationship between collaboration and PLC- related conditions (RQ5)

In Table 5, we provide the Pearson correlation coefficients that we derived from computing the intercorrelations of collaboration and PLC- related conditions for each LS cycle. For all four cycles the correlations appear significant. This means that teachers´ appreciation of collaboration and their appreciation of the PLC related conditions apparently is strongly connected.

Table 5
Intercorrelations among teachers' collaboration and PLC related conditions, per cycle.

	PLC related conditions cycle 1	PLC related conditions cycle 2	PLC related conditions cycle 3	PLC related conditions cycle 4
Collaboration cycle 1	.65**			
Collaboration cycle 2		.54**		
Collaboration cycle 3			.49*	
Collaboration cycle 4				.61**

** Correlation is significant at the .01 level (two-tailed)
* Correlation is significant at the .05 level (two-tailed)

school related conditions (RQ6)

In Tables 6 and 7, we provide the mean scores for the school related conditions: the presence of a supportive school leader (Table 6), and provided time (Table 7). In general, teachers appear to be satisfied with the provided time, but they seem less positive about the support of their school management. Besides, the differences between the schools in supportive school management are big, in particular the schools with only one teacher participating in the PLCs (schools 2, 4, 5 and 11) seem to support the least.

Table 6
Mean scores for teachers' school related conditions supportive school leader, overall and per school.

Item	Cycle 1	Cycle 2	Cycle 3	Cycle 4
Supportive school leader	3.8	3.7	3.5	3.3
School1 (3 teachers)	3.3	4.0	5.0	4.7
School2 (1 teacher)	4.0	1.0	3.0	1.0
School3 (2 teachers)	4.5	3.5	4.0	2.5
School4 (2 and 1 teachers)	3.5	4.0	2.0	2.0
School5 (1 teacher)	3.0	2.0	1.0	2.0
School6 (3 and 1 teachers)	4.0	4.0	5.0	5.0
School7 (2 teachers)	4.5	4.0	4.5	4.0
School8 (4 and 6 teachers)	3.5	3.5	2.5	3.3
School9 (2 teachers)	4.0	4.0	3.0	4.0
School10 (3 teachers)	4.7	4.8	5.0	4.3
School11 (1 teacher)	3.0	3.0	1.0	1.0
School12 (2 teachers)	2.5	3.0	3.0	3.0
School13 (2 and 1 teachers)	3.5	4.0	-	-

Table 7
Mean scores for teachers' school related conditions provided time, overall and per school.

Item	Cycle 1	Cycle 2	Cycle 3	Cycle 4
Time	4.3	4.3	4.6	4.0
School1 (3 teachers)	4.3	4.3	5.0	4.7
School2 (1 teacher)	4.0	5.0	4.0	3.0
School3 (2 teachers)	4.0	4.5	4.5	4.5
School4 (2 and 1 teachers)	5.0	5.0	5.0	5.0
School5 (1 teacher)	3.0	4.0	5.0	5.0
School6 (3 and 1 teachers)	4.7	4.3	5.0	5.0
School7 (2 teachers)	2.5	3.0	4.5	4.5
School8 (4 and 6 teachers)	4.5	4.3	4.3	2.8
School9 (2 teachers)	5.0	4.0	5.0	5.0
School10 (3 teachers)	5.0	4.3	4.3	4.0
School11 (1 teacher)	1.0	3.0	3.0	1.0
School12 (2 teachers)	5.0	5.0	4.5	5.0
School13 (2 and 1 teachers)	4.5	4.0	-	-

relationship with background variables (RQ7)

To investigate whether differences between the LS teams can be explained by background variables, the independent sample t-tests that served to assess the differences between gender, subject matter and teaching qualification found no results. The one way ANOVAs used for age and teaching experience, made clear that age in cycles 1 ($F(3, 22) = 3.079$, $p < .05$) and 2 ($F(3,22) = 2.329$, $p < .01$) explains differences in collaboration between the teams: in the first year the youngest group of teachers (under 30) felt clearly less happy about the collaboration in their teams.

Conclusion and discussion

The main research question in this study was: what is the feasibility and value of LS as a new approach for teacher learning for Dutch teachers? The findings show that teachers experience LS in general as feasible and instructive. Differences between the LS teams were also found, in particular in the first year, due to interpersonal and conditional factors.

Zooming in on the LS cycle on the basis of the four features of Lewis et al. (2009), LS seems feasible and valuable as learning experience for the teachers involved, in particular the research lesson and the reflection part, and to a lesser degree the planning and investigation parts. This is a fairly consistent picture during the two years and the four cycles. The third and fourth features, the performance of the research lesson, the observations of and the interviews with the pupils, and the reflection meeting, were very much appreciated by the teachers of both PLCs.

However, the first feature, investigation, that teachers find less feasible and valuable, is something that teachers are not accustomed to do in the Dutch educational context where they are used to work with readymade textbooks, especially for mathematics and in a lesser degree for Dutch language. Furthermore, teachers in general find it difficult to think of goals for student learning and development, let alone long term goals, and also, to study thoroughly the content area in all its facets (key concepts, existing curricula, standards, learning trajectory, research). After the first year, the project group made it a point of special interest.

Also, the planning part was not always easy. It often took quite some time to agree about the theme of the research lesson. Another thing that was not very popular was writing down the instructional plan including the goals for pupil learning and development, anticipated pupil thinking, data collection points, and rationale for lesson design. Making pupils' learning and thinking visible turned out to be problematic at times as well. Nevertheless, the research lessons developed were most of the time very original, which, of course, is very time consuming. Probably all these aspects together made that teachers in general find the planning part also less feasible and valuable than the research lesson and reflection parts.

Generally, with regard to collaboration in LS teams, teachers are satisfied. LS seems to enable teachers to strenghten professional community, and to build the norms and tools needed for instructional improvement (Lave & Wenger, 1991; Lewis et al., 2009: 286). However, the differences between the teams are sometimes big, due to all sorts of interpersonal differences in the teams, in particular age, but also competences, character and dominance. Although, due to changes in team composition and team size, the differences between the teams became smaller during the second year. It seems to be important to keep collaboration on the agenda all the time.

The PLC related conditions (Thurlings & Den Brok, 2014), such as the quality of the facilitators, the given professional 'room' and guide lines, and the time provided by the school seemed to be in order. As to the supportive school leader, teachers seemed to be less enthusiastic, particularly the teachers that are the only ones at their schools participating in LS, whereas this support is an important factor for the transition of LS to the twelve schools in the third year of the project.

Based on the experiences in project year two, and to facilitate this transition, the project group has decided on some adaptations for project year three. Firstly, to make the LS

less time consuming by developing 'ordinary' instead of extraordinary lessons. Secondly, to pay more and explicit attention to the investigation and planning parts, including the writing up in all cycles. Thirdly, the LS in cycle 5 will be prepared in the PLC context and the research lessons will be given and observed by colleagues of the schools; at the same time an in-school LS team will be formed for cycle 6. In cycle 6, the LS will be performed in in-school LS teams, led by the PLC teacher as LS facilitator; the PLC then will offer an intervision platform, and the teacher educators will coach the individual PLC teachers at their own schools as LS facilitators. At the same time, a course developed in consultation with the schools will be organized for the PLC teachers together with their school leaders about pupil, teacher and organizational learning, forms of leadership, and school culture development and change to stimulate them to have a common theoretical basis and to speak a common language with a view on LS as professionalization approach in their schools. Research after the third year will show whether and how this way of transition of LS into the schools worked out.

Since teachers themselves find LS feasible and valuable, and it is expected that this will result in the application of what is learned in daily practice via changes in teachers' knowledge and beliefs, changes in professional community and changes in teaching-learning resources (the three pathways of the theoretical model of Lewis et al. 2009). In this PLC project, we are also investigating these pathways and ultimate effects of LS to provide an 'proof of existence' of the potential effectiveness of LS in the Dutch context. Via annual interviews we are trying to gain insight into whether LS is affecting each of the pathways. By means of observations and pupil surveys we are trying to gain insight into changes in teachers´ instructional behavior. We think the latter is necessary because to date, much LS research, and also this paper, is based on self-reporting by participants.

So far, the project results have demonstrated that LS has potential in the Dutch context as a model for teacher learning, provided that interpersonal and conditional factors are respected. However, this paper also presents some limitations. Though based on some 30 teachers and with a longitudinal design, this quantitative approach does not provide us with a full picture. In the questionnaire, teachers have made frequent use of the room left for comments. A following version of this paper will be illustrated with teachers´ quotes in order to give more insight in the nature and depth of teachers' experiences with LS. Another limitation is the sample representativeness which is hindering its generalizability to other LS efforts, because these were willing teachers in interschool PLCs. For follow-up studies, we are also planning to investigate feasibility and value on a mix of willing and less willing teachers in the context of their own schools.

To conclude with regard to the chosen LS approach in this project: we are now following the US LS version of Stepanek et al. (2007), with an adaptation by Dudley (2011). However, teaching is a cultural activity (Stigler & Hiebert, 1999, 2016), and various conceptualizations of LS and associated forms of activities in LS have already been developed (e.g. reviews of Xu & Pedder, 2014; Huang & Shimizu, 2016). It is plausible that we are going to adapt LS to our own education system, and find our own conceptualization of LS for the Dutch context.

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Appendix 1: The final collaboration and PLC-related conditions scales, school-related conditions items, and descriptive statistics (N =23)

Collaboration scale	Mean	Min.	Max.	Std. Dev.
1. Er was goed leiderschap in de groep.	3,9	3	5	,73
2. Groepsleden wisten wat de bedoeling was en begrepen elkaar hierin.	3,9	2	5	,83
3. Groepsleden wisten welke taken er waren en hoe deze verdeeld werden.	3,9	2	5	,95
4. Groepsleden ondersteunden elkaar.	4,0	3	5	,69
5. Groepsleden gaven elkaar feedback.	3,9	2	5	,79
6. De groepsleden hadden vertrouwen in elkaar.	4,1	3	5	,65
7. De groepsleden communiceerden goed met elkaar.	3,8	2	5	,76
8. De groep had het gevoel een groep te zijn.	3,7	2	5	,91

PLC-related conditions scale	Mean	Min.	Max.	Std. Dev.
1. Begeleiding en ondersteuning vakdidactici	4,5	3	5	,59
2. Expertise vakdidactici	4,5	4	5	,51
3. Gestelde kaders door vakdidactici	4,2	3	5	,64
4. Gegeven (professionele) ruimte door vakdidactici	4,5	4	5	,51
5. Omvang PLG (ca. 15 deelnemers)	4,4	3	5	,65
6. Samenstelling PLG	4,5	2	5	,78
7. Grootte eigen LS-groep	4,6	3	5	,65
8. Samenstelling eigen LS-groep	4,3	2	5	,87

School-related conditions	Mean	Min.	Max.	Std. Dev.
1. Ondersteunende schoolleiding	3,3	1	5	1,3
2. Beschikbaar gestelde tijd	4,0	1	5	1,2

Appendix 2: Feasibility of Lesson Study

	Cycle 1 (n=19-28)	**Cycle 2** (n=16-27)	**Cycle 3** (n=12-22)	**Cycle 4** (n=12-24)	**overall mean**
Investigation					
1. looking for backgrounds	3,2	3,8	3,2	3,1	
2. studying backgrounds	3,3	3,5	3,2	3,2	
3. discussing backgrounds	3,3	3,7	3,1	3,4	
mean	**3.3**	**3.7**	**3.2**	**3.2**	**3.4**
Planning					
4. formulating goals	3,2	3,7	3,0	3,6	
5. developing instructional plan	3,9	3,7	3,6	3,9	
6. anticipating pupil solutions		3,7	3,5	3,3	
7. formulating data collection points		3,6	3,3	3,4	
mean	**3.6**	**3.7**	**3.4**	**3.6**	**3.6**
Research lesson					
8. conducting lesson	4,3	3,8	3,8	3,4	
9. observing pupils	4,0	3,9	3,9	4,1	
10. collecting data		3,7	3,7	4,1	
11. interviewing pupils		4,0	3,8	3,8	
12. reteaching lesson	4,1	4,0	3,9	4,0	
13. observing pupils	4,2	4,0	4,1	4,3	
14. collecting data		3,7	3,8	4,2	
15. interviewing pupils		3,9	3,9	4,2	
mean	**4.2**	**3.9**	**3.9**	**4.0**	**4.0**
Reflection					
16. post-lesson colloquium	4,5	4,2	4,4	4,1	
17. sharing and discussing data		3,8	3,6	4,0	
18. discussing possible implications		4,0	4,2	4,2	
19. revising	3,6	4,0	4,0	4,1	
20. post reteaching colloquium	4,2	4,1	4,2	4,1	
21. sharing and discussing data		3,9	3,5	3,7	
22. discussing possible implications		3,8	3,7	4,1	
23. revising		3,8	3,8	4,0	
24. summarizing in product	3,4	3,5	3,5	3,9	
25. evaluation- and reflection meeting	3,8	4,0	3,8	4,0	
mean	**3,9**	**3,9**	**3,9**	**4,0**	**3,9**

Appendix 3: Value of Lesson Study

	Cycle 1 (n=19/28)	**Cycle 2** (n=17/28)	**Cycle 3** (n=15/22)	**Cycle 4** (n=12/24)	**Overall mean**
Investigation					
1. looking for backgrounds	3,4	3,6	3,2	3,1	
2. studying backgrounds	3,5	3,6	3,6	3,2	
3. discussing backgrounds	3,2	3,7	3,4	3,2	
mean	**3,4**	**3,6**	**3,4**	**3,2**	**3,4**
Planning					
4. formulating goals	3,7	3,8	3,7	3,7	
4. developing instructional plan	4,4	3,8	3,7	3,7	
6. anticipating pupil solutions		4,0	3,8	3,5	
7. formulating data collection points		3,8	3,6	3,6	
mean	**4,1**	**3,9**	**3,7**	**3,6**	**3,8**
Research lesson					
8. conducting lesson	4,6	4,1	4,3	4,3	
9. observing pupils	4,4	4,1	4,1	4,2	
10. collecting data		3,8	3,7	4,0	
11. interviewing pupils		4,2	4,0	3,6	
12. reteaching lesson	4,4	4,1	4,2	4,3	
13. observing pupils	4,3	4,1	4,1	4,3	
14. collecting data		4,0	3,5	4,0	
`5. interviewing pupils		4,0	3,9	4,1	
mean	**4,4**	**4,1**	**4,0**	**4,1**	**4,2**
Reflection					
16. post-lesson discussion	4,6	4,3	4,4	4,3	
17. sharing and discussing data		3,9	3,8	4,0	
18. discussing possible implications		4,2	4,1	4,3	
19. revising	3,6	4,1	4,0	4,2	
20. post reteaching discussion	4,3	4,2	4,0	4,3	
21. sharing and discussing data		3,9	3,6	3,7	
22. discussing possible implications		4,0	3,7	4,0	
23. revising		3,8	3,7	3,9	
24. summarizing in product	3,8	3,6	3,4	3,8	
25. evaluation- and reflection meeting	3,8	3,9	3,7	3,8	
mean	**4,0**	**4,0**	**4,0**	**4,0**	**4,0**